

REMARKS

Claims 1-8 remain pending after this amendment.

Applicants' Invention

The present invention relates to a thermoplastic resin composition comprised of:

[A] 100 parts by weight of a polyacetal resin or thermoplastic aromatic polyester resin,

[B] 0.1 to 20 parts by weight of a graft polymer in which (B-2) a vinyl (co)polymer component comprising at least one vinyl compound is graft-polymerized on (B-1) an olefin polymer as a backbone polymer, and

[C] 0.1 to 10 parts by weight of a liquid ethylene/ α -olefin random copolymer comprising ethylene and an α -olefin having 3 to 20 carbon atoms, which random copolymer has:

(i) a proportion of a structural unit derived from ethylene of from 20 to 80 mol% and a proportion of a structural unit derived from α -olefin of from 20 to 80 mol% based on all structural units,

(ii) a number average molecular weight (Mn) of from 500 to 10000,

(iii) a molecular weight distribution (M_w/M_n) determined by a ratio of a weight average molecular weight (M_w) to a number average molecular weight (Mn) of from 1.2 to 3, and

(iv) a pour point of lower than 20 °C.

In the resin composition, the thermoplastic resin [A] and the liquid ethylene/α-olefin random copolymer [C] disperse uniformly without phase separation. Thereby such resin compositions have excellent molding processability. That is, there is neither deterioration in appearance such as surface wetting and peeling of molded articles, nor mold contamination when formed into molded articles, because of improved mold-releasability during molding.

The resin compositions can be used to prepare molded articles having excellent sliding properties, wear resistant properties and impact resistance without impairing the mechanical properties of resin articles.

Furthermore, blending the graft copolymer [B] with the thermoplastic resin [A] in the above amounts, permits the liquid ethylene/α-olefin random copolymer [C] to be dispersed homogeneously in the resin [A] without occurrence of phase separation, enabling a resin composition having the excellent properties to be prepared. When the resin composition is molded into molded articles, the molded article surface has no wetting nor inferior appearance such as peeling. In molding, the resin composition has no mold contamination because the mold releasability thereof is improved, and has excellent mold processability and, further, the impact strength is lowered.

The advantages of the present invention are clearly described in the present specification as shown in Example 1, and Co-Examples 2 and 3. In Co-Example 2, the mixing procedure of Example 1 was repeated except that the liquid ethylene/α-olefin random copolymer was not used. In Co-Example 3, the mixing procedure of Example 1 was repeated except that the ABS resin was not used.

The results are shown in Table 1 below:

Table 1

	Ex. 1	Co-Ex.2	Co-Ex.3
[A] Polyacetal resin	100	100	100
[B] Graft copolymer	5	5	NOT USED
[C] Ethylene/α-olefin copolymer:EP1	3	NOT USED	3
Mold contamination	AA	AA	CC
Molded article appearance	AA	AA	CC
Dispersed particle diameter (μm)	0.4-1.0	-*1	0.3-4.0
Coefficient of Dynamic friction	0.1597	0.3237	*2 Measurement was unfeasible.
Abrasion loss (mg)	27.4	72.7	
Izod impact strength (J/m)	115	110	79

*1: The component [C] was not added, so that there were no data.

*2: The surface of the molded article had much roughness so that measurement could not conducted.

In Co-Example 2, the coefficient of dynamic friction is too high, and abrasion loss is too great. In Co-Example 3, since the component is poorly dispersed, the coefficient of dynamic friction is too high, and abrasion loss is too great.

In the cited references, a composition containing only a combination of the thermoplastic resin [A] and the graft copolymer [B], or the thermoplastic resin [A] and the liquid ethylene/ α -olefin random copolymer [C] are disclosed. The combination of the liquid ethylene/ α -olefin random copolymer [C] with the graft copolymer [B] is neither taught nor suggested.

Applicants' invention is neither disclosed nor suggested by the cited prior art.

Rejection of Claims 1-8 under 35 USC 103(a)

Claims 1-8 stand rejected under 35 USC 103(a) as being unpatentable over either Kodama et al or Kato et al in view of Hirano. This rejection respectfully is traversed.

Kodama discloses a thermoplastic resin composition comprising a mixture of:

(A) a rubber-reinforced styrene resin which is obtained by graft polymerizing styrene and acrylonitrile in the presence of a rubbery polymer selected from the group consisting of polybutadiene, ethylene-propylene-diene monomer rubber and acrylate copolymers (ABS resin),

(B) polybutylene terephthalate (PBT),

(C) maleimide copolymer comprising (i) N-phenylmaleimide, (ii) styrene and (iii) acrylonitrile or of acrylonitrile and methyl methacrylate, and

(D) an epoxy group-containing olefinic copolymer.

Kodama fails to teach the presence of a liquid ethylene/ α -olefin random copolymer [C] in the disclosed composition.

By way of further distinction, the composition of Kodama comprises maleimide copolymer and an epoxy group-containing olefin copolymer, which differs from the composition of the present invention.

By blending the graft copolymer [B] with the thermoplastic resin [A] in the recited amounts, liquid ethylene/ α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A] with the occurrence of phase separation. A resin composition having low mold contamination, excellent moldability, excellent frictional wear properties, and favorable impact resistance can be obtained.

Kato discloses a polybutylene terephthalate resin composition comprising:

(A) a polybutylene terephthalate resin;

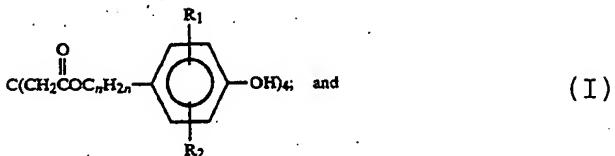
(B) a copolymer of acrylonitrile and styrene;

(C) a graft copolymer comprising:

(C1) from 65 to 75% by weight of copolymer comprising from 75 to 85% by weight of ethylene and from 25 to 15% by weight of glycidyl methacrylate, and

(C2) from 25 to 35% by weight of a copolymer of acrylonitrile and styrene;

(D) from 0.05 to 0.5 part by weight of a hindered phenol compound represented by formula (I):



wherein n represents an integer of from 0 to 6, and R₁ and R₂ each represents an alkyl group having from 1 to 6 carbon atoms, a substituted alkyl group having from 1 to 6 carbon atoms, or a cycloalkyl group having from 3 to 6 carbon atoms; and

(E) from 0.05 to 0.5 part by weight of a thioether compound represented by the following formula (II):



wherein m represents an integer of from 1 to 4, R₃ represents an alkyl group, and R₄ represents an alkylene group.

Kato relates to a connector, which is lightweight and excellent in dimensional stability, heat resistance, mechanical property, and productivity, and also in fitting feeling.

However, Kato is also silent with respect to the presence of a liquid ethylene/α-olefin random copolymer [C] as required by applicants.

Both Kodama and Kato fail to appreciate that by blending the graft copolymer [B] with the thermoplastic resin [A] in the

above amounts, liquid ethylene/ α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A] without occurrence of phase separation. Thereby a resin composition having low mold contamination, excellent moldability, excellent frictional wear properties, and favorable impact is prepared.

These advantages are clearly demonstrated in applicants' specification, such as at Examples 6-7 and Co-Example 7.

By blending the graft copolymer [B] with the thermoplastic resin [A] in the above amounts, liquid ethylene/ α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A] without occurrence of phase separation. A resin composition having low mold contamination, excellent moldability, excellent frictional wear properties, and favorable impact is thus produced.

The advantages of the present invention are clearly described, for example, at Examples 6 and 7 and Co-Example 7 of the present specification.

The compositions of Examples 6 and 7 contain [A] the polybutylene terephthalate, [B] ABS resin and the liquid ethylene/ α -olefin random copolymer [C]. By contrast, the composition of Co-Example 7 does not contain the liquid ethylene/ α -olefin random copolymer [C]. The resulting polybutylene terephthalate composition was molded to prepare a

molded article and it was evaluated in the same manner as in Example 1. The results are shown in Table 3:

Table 3

		Ex. 6	Ex. 7	Co.Ex.7
Resin composition				
[A] Polybutylene terephthalate resin		100	100	100
[B] Graft copolymer (ABS)		5	5	5
[C] Ethylene / α -olefin copolymer	EP1	3	5	NOT USED
	EP2			
	EP3			
	EP4			
Evaluation result				
Mold contamination		AA	AA	AA
Molded article appearance		AA	AA	AA
Dispersed particle diameter (μm)		0.2-1.0	0.2-2.0	-*1
Coefficient of Dynamic friction		0.1442	0.1367	0.3355
Abrasion loss (mg)		2.6	2.4	12.5
Izod impact strength (J/m)		76	68	63

*1: The component [C] was not added, so that there were no data.

In Co-Example 7, the coefficient of dynamic friction is too high, and abrasion loss is too great.

Unless the liquid ethylene/ α -olefin random copolymer [C] and the graft copolymer [B] are used in combination, it is difficult to improve the sliding properties, wear resistant properties and impact resistance of articles. That is, the objects of the present invention cannot be accomplished.

Further, the claimed combination of liquid ethylene/ α -olefin random copolymer [C] with the graft copolymer [B] as

recited in applicants' claims is neither taught nor suggested by Kodama and Kato. Nor do the cited references teach the claimed combination of components [A], [B] and [C].

The additionally-cited Hirano reference does not cure the deficiencies of Kodama et al or Kato et al.

Hirano discloses a molding resin composition comprising:

(A) 100 parts by weight of a resin selected from the group consisting of polyacetal resin, ABS resin, polyamide resin, polyphenylene oxide resin, polyimide resin, thermoplastic polyester resin, polycarbonate resin, epoxy resin, thermosetting unsaturated polyester resin and phenolic resin, and

(B) 0.1-15 parts by weight of, at room temperature, a liquid ethylene- α -olefin random copolymer having polar groups,

wherein (a) said ethylene- α -olefin random copolymer comprises 30-70 mole % of ethylene unit and 30-70 mole % of α -olefin units based on its total structural units, and wherein said ethylene- α -olefin random copolymer having polar groups has (b) a number average molecular weight (M_n) of 500-10000, and (c) a molecular weight distribution (M_w/M_n) represented by the ratio of the weight average molecular weight (M_w) to the number average molecular weight (M_n) of 1.2-3.

In Hirano, a liquid ethylene- α -olefin random copolymer having polar groups is present in the composition. By contrast, a thermoplastic polyester resin [A], graft copolymer [B] and

liquid ethylene/ α -olefin random copolymer [C] are used in combination in applicants' claimed invention. That is, the graft copolymer [B] is present as an essential component in the present invention. The graft copolymer is different from the liquid ethylene- α -olefin random copolymer having polar groups.

The graft copolymer [B] of the present invention is comprised of an olefin polymer (B-1) as a backbone polymer, and a vinyl (co) polymer (B-2) as a graft chain. Due to the presence of the two different polymeric components in the graft copolymer [B] molecule, the compatibility between thermoplastic polyester resin [A] and the liquid ethylene- α -olefin random copolymer [C] is much improved.

The polar groups in the liquid ethylene- α -olefin random copolymer of Hirano are low molecular weight and accordingly do not improve the compatibility between thermoplastic polyester resin [A] and the liquid ethylene- α -olefin random copolymer [C].

Due to the presence of the graft copolymer [B], the liquid ethylene- α -olefin random copolymer [C] can be dispersed homogeneously in the resin [A] without occurrence of phase separation. As a result, the resin compositions have excellent molding processability. That is, neither deterioration in appearance such as surface wetting and peeling of molded articles, nor mold contamination occurs when formed into molded articles due to improved mold-releasability in molding.

These effects of the graft copolymer [B] are shown in the following Table 2:

Table 2

		Ex. 6	Hirano Trace
[A] Polyacetal resin		100	100
[B] Graft copolymer		5	NOT USED
[C] Ethylene α -olefin copolymer	EP1	3	NOT USED
*1) copolymer having polar groups			3
Dispersed particle diameter (μm)		0.1-1.0	0.4~10
Coefficient of Dynamic friction		0.1442	0.2031
Abrasion loss (mg)		2.6	1.0
Izod impact strength (J/m)		76	46

*1: The Ethylene/ α -olefin copolymer is modified by maleic anhydride as described in Hirano Examples.

Since the graft copolymer [B] is present in the Example 6 composition, the compatibility between thermoplastic polyester resin [A] and the liquid ethylene/ α -olefin random copolymer [C] is much improved, and the dispersed particle diameter of the Example 6 composition is smaller than that of Hirano trace. The resin composition has excellent molding processability. That is, there is neither deterioration in appearance such as surface wetting and peeling of molded articles, nor mold contamination when formed into molded articles. The combination of components

taught by Hirano does not suggest applicants' recited combination of [A], [B] and [C].

The Examiner at pages 3-4 of the Final Rejection takes issue with applicants' position on the ground that the comparative data relied upon does not, in effect, direct itself to the teachings of the references, and that Hirano "specifically discloses that the addition of the low molecular weight ethylene/alpha-olefin copolymer to an ABS resin will increase mold releasability and friction wear resistance." The Examiner concludes that "such improvement would appear to flow naturally from the teachings of Hirano et al".

Applicants reiterate their disagreement with the Examiner's position. Hirano teaches the addition of the low molecular weight ethylene/alpha-olefin polymer to "one kind of resin" selected from the group consisting of polyacetal resin, ABS resin, polyamide resin, polyphenylene oxide resin, polyimide resin, thermoplastic polyester resin, polycarbonate resin, epoxy resin, thermosetting unsaturated polyester resin and phenolic resin. See the paragraph bridging columns 1 and 2 of the reference. The reference at worst expressly teaches away from a composition which contains a mixture of two or more of the above resins, and at best merely teaches the combination of a low molecular weight polymer with other polymers. Neither conclusion assists that Examiner.

As discussed at column 1, lines 38-49 of the reference, one problem with the addition of a low molecular weight ethylene/alpha-olefin polymer to such resins is incompatibility, which results in phase separation between the respective components. Hirano apparently attempts to address this problem by inclusion of polar groups in the low molecular weight resin.

By contrast, applicants address this problem by the further inclusion into a mixture of a thermoplastic polyester resin [A] and the low molecular weight ethylene/alpha-olefin polymer [C] of the recited graft copolymer component [B] having a specific structure - i.e., a vinyl compound grafted on an olefin polymer backbone. Exemplary vinyl graft components are recited in pending claim 2, and include vinyl aromatic compounds, vinyl cyanide compounds, and (meth)acrylic ester compounds.

The additional presence of the graft copolymer overcomes the problem of phase separation - a problem which Hirano attempts to solve in a completely different way, thus failing to teach applicants' invention.

In view of such distinctions, one of ordinary skill in the art would not look to Hirano to solve the problem of phase separation in the manner suggested by the Examiner - instead, one of ordinary skill in the art would modify the low molecular

weight polymer in the manner suggested by Hirano. To yield applicants' invention based on the teachings of Hirano, one of ordinary skill in the art would, in violation of the teachings of Hirano, not only have to employ a mixture of base polymers together with the low molecular weight polymer, but would have to select the proper mixture of base polymers utilizing the graft copolymer specified by applicants' claims. Nothing in Hirano leads one of ordinary skill in the art to such a result.

In view of the above, applicants believe that the Examiner has failed to present a *prima facie* case of obviousness. As such, the Examiner's asserted objections to the comparative data presented by applicants are without basis. The rejection is without basis and should be withdrawn.

The application is now believed to be in condition for allowance and an early indication of same is solicited.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a second month extension of time for filing a reply in connection with the present application, and the required fee of \$310.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By John H. Stewart # 28,808 fm
Raymond C. Stewart, #21,066
P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000

RCS/JWH/sh
1155-0245P